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Franz et al.

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(54) **PROGRESSIVE IRON SET**

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(73) Assignee: **Acushnet Company**, Fairhaven, MA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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(22) Filed: **Aug. 19, 2014**

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Related U.S. Application Data

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(51) **Int. Cl.**
A63B 53/04 (2015.01)
A63B 53/00 (2015.01)

(52) **U.S. Cl.**
CPC ***A63B 53/047*** (2013.01); *A63B 2053/005* (2013.01); *A63B 2053/0408* (2013.01); *A63B 2053/0491* (2013.01)

(58) **Field of Classification Search**
CPC A63B 53/047; A63B 2053/0408; A63B 2053/005; A63B 2053/0491
See application file for complete search history.

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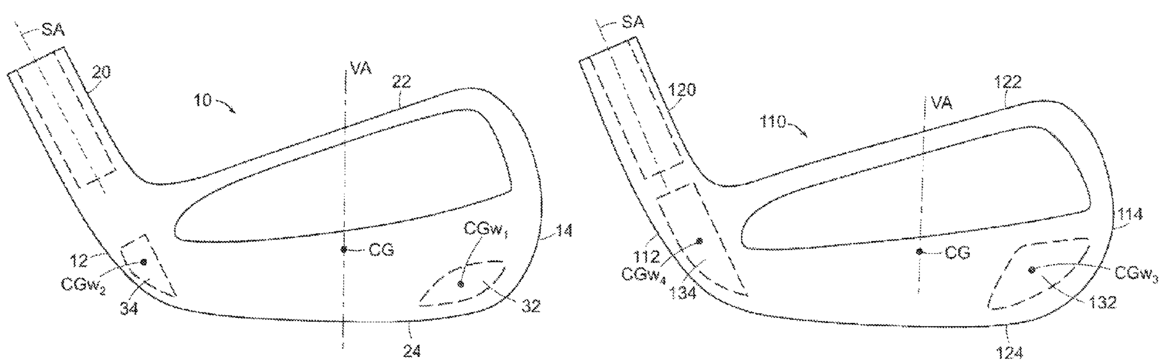
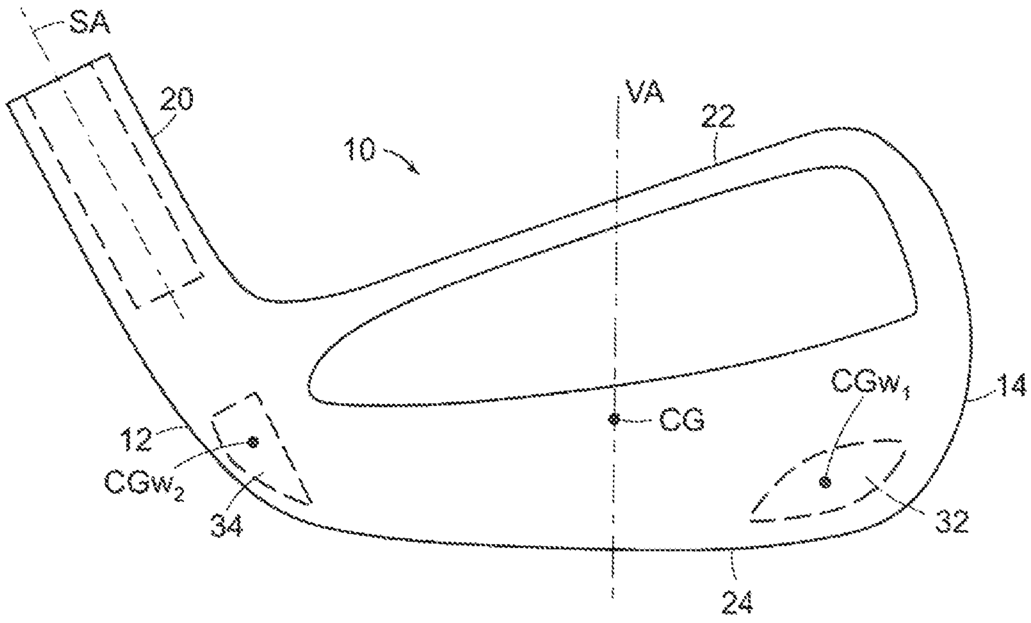
Primary Examiner — Stephen Blau

(57) **ABSTRACT**

The present invention is direct to a set of golf clubs comprising long irons, mid-irons and short irons. The long irons have a first center of gravity positioned horizontally from the face center by a first distance. The mid-irons have a second center of gravity positioned horizontally from the face center by a second distance. The short irons have a third center of gravity positioned horizontally from the face center by a third distance.

9 Claims, 9 Drawing Sheets

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20
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VA
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CGw1
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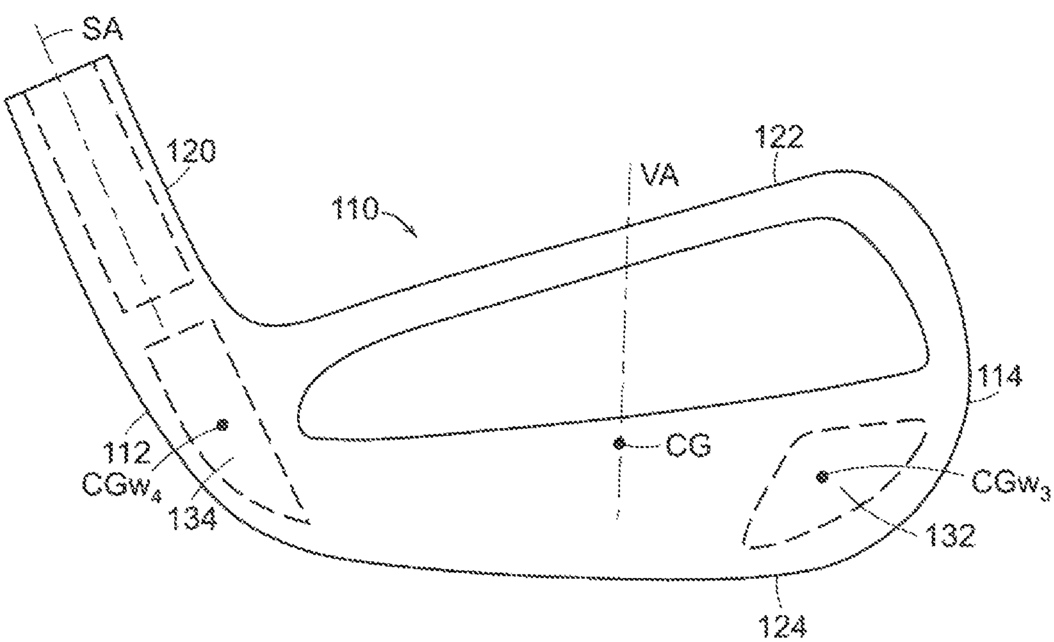
CG
CGw2
34
32
24

FIG. 1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CGw3
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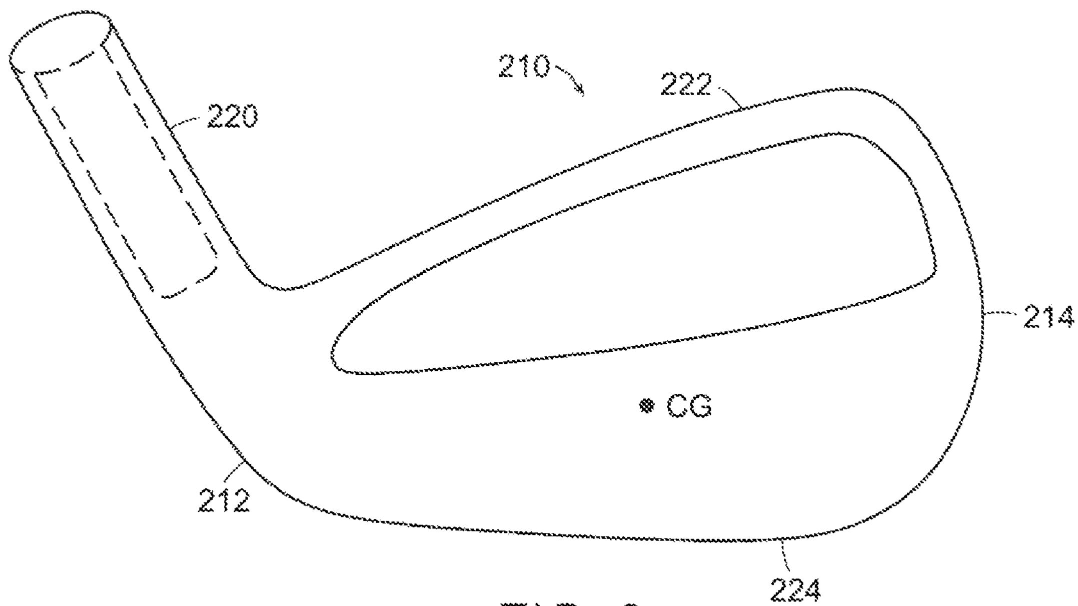
132
124

FIG. 2



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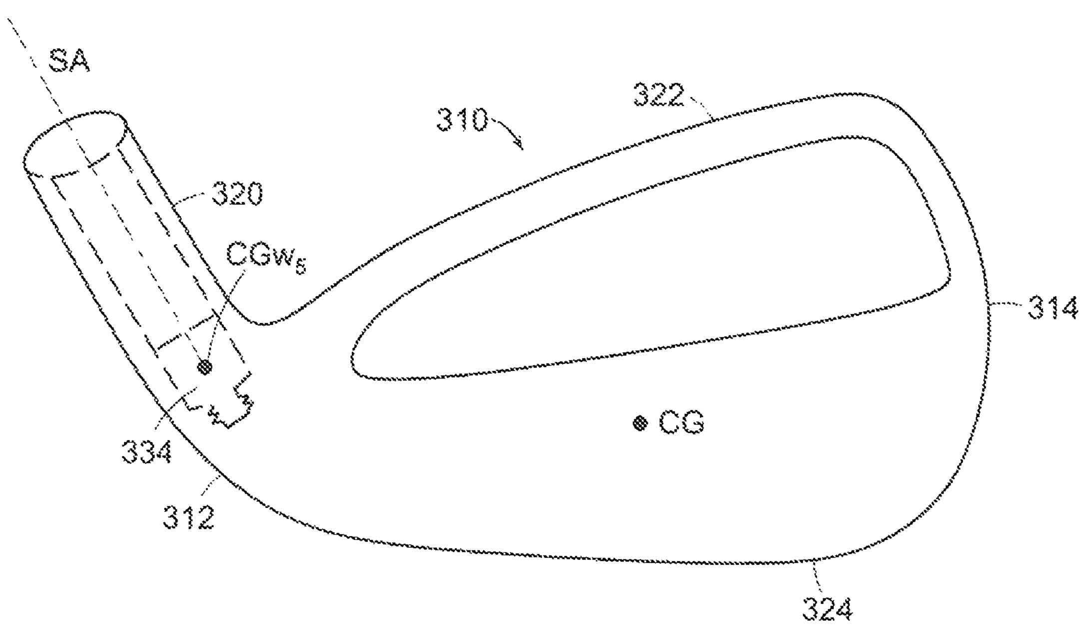

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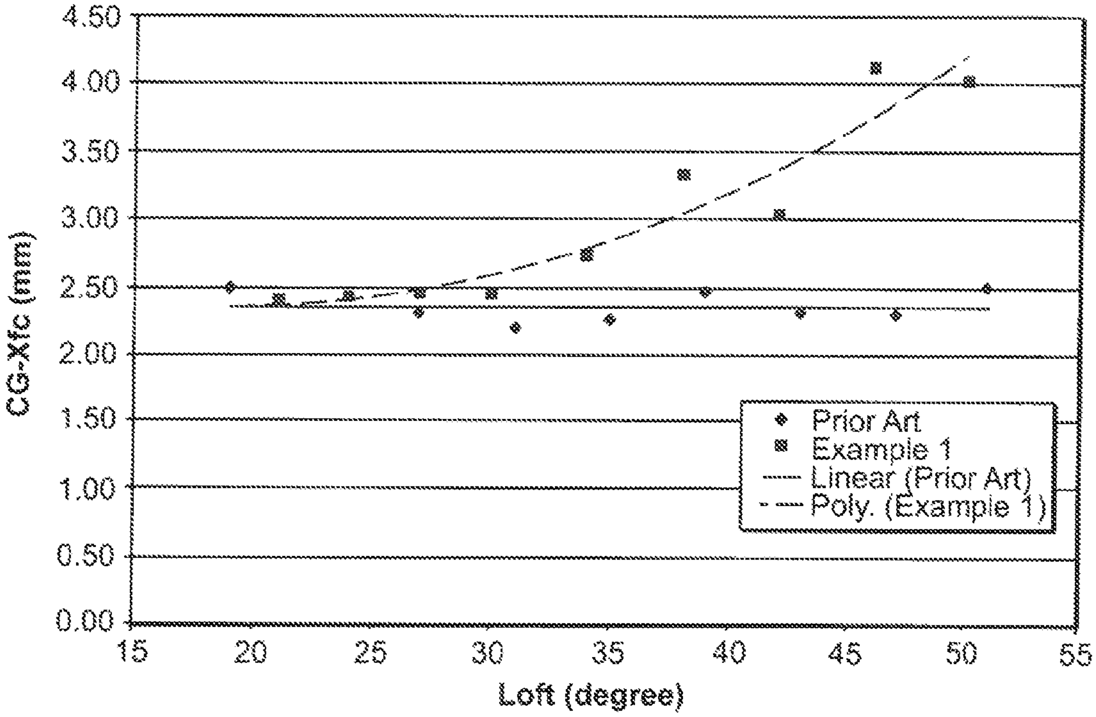
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4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
CG-Xfc (mm)
15 20 25 30 35 40 45 50 55
Loft (degree)
Prior Art
Example 1
Linear (Prior Art)
Poly. (Example 1)

FIG. 5

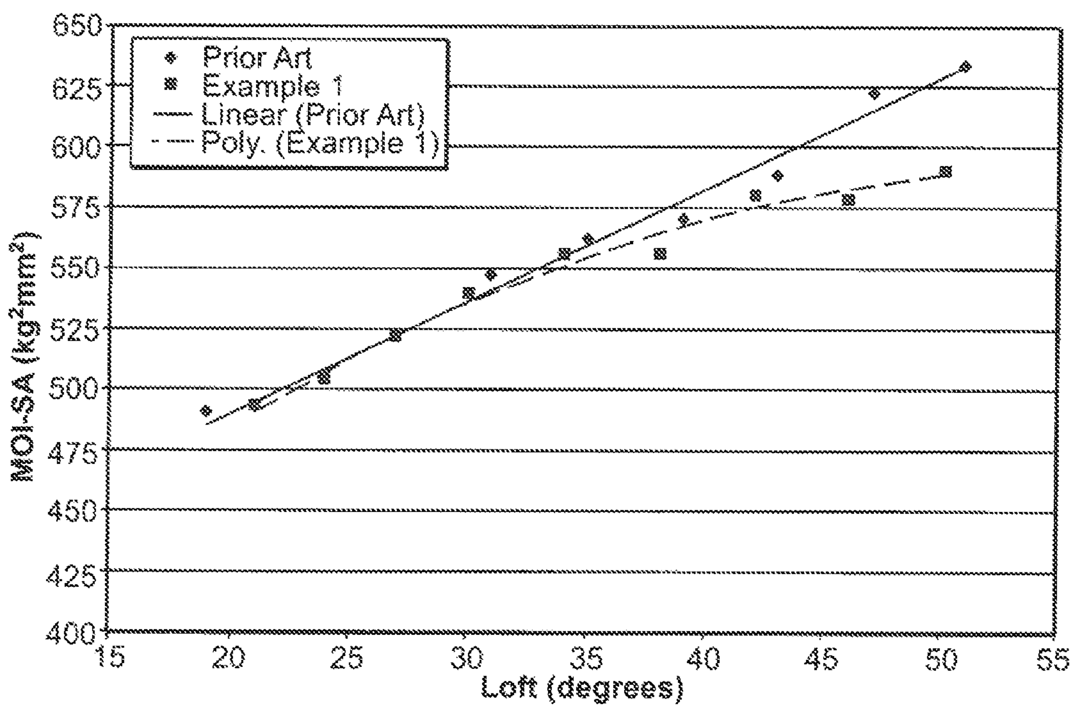
650
625
600
575
550
525
500
475
450
425
400
MOI-SA (kg2mm2)
15 20 25 30 35 40 45 50 55
Loft (degrees)
Prior Art
Example 1
Linear (Prior Art)
Poly. (Example 1)

FIG. 6

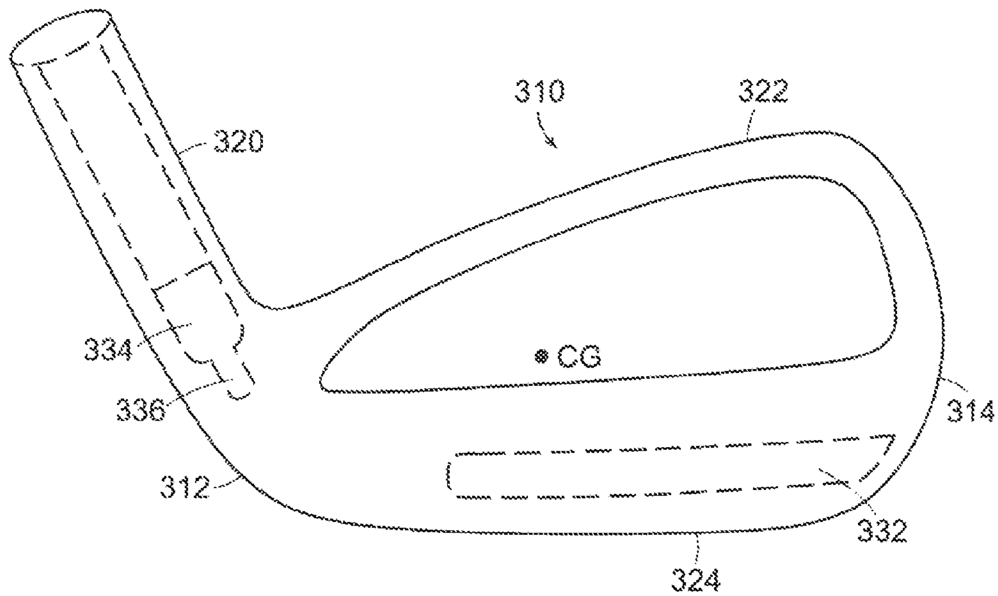

FIG. 7

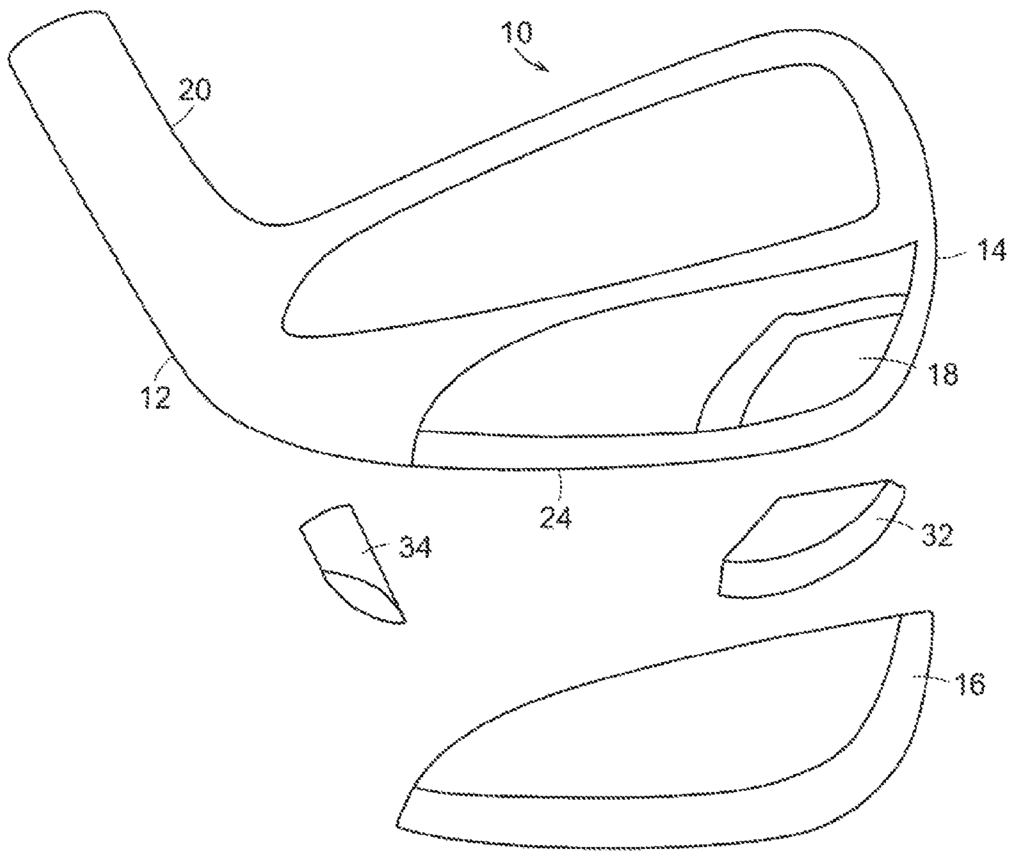

FIG. 8

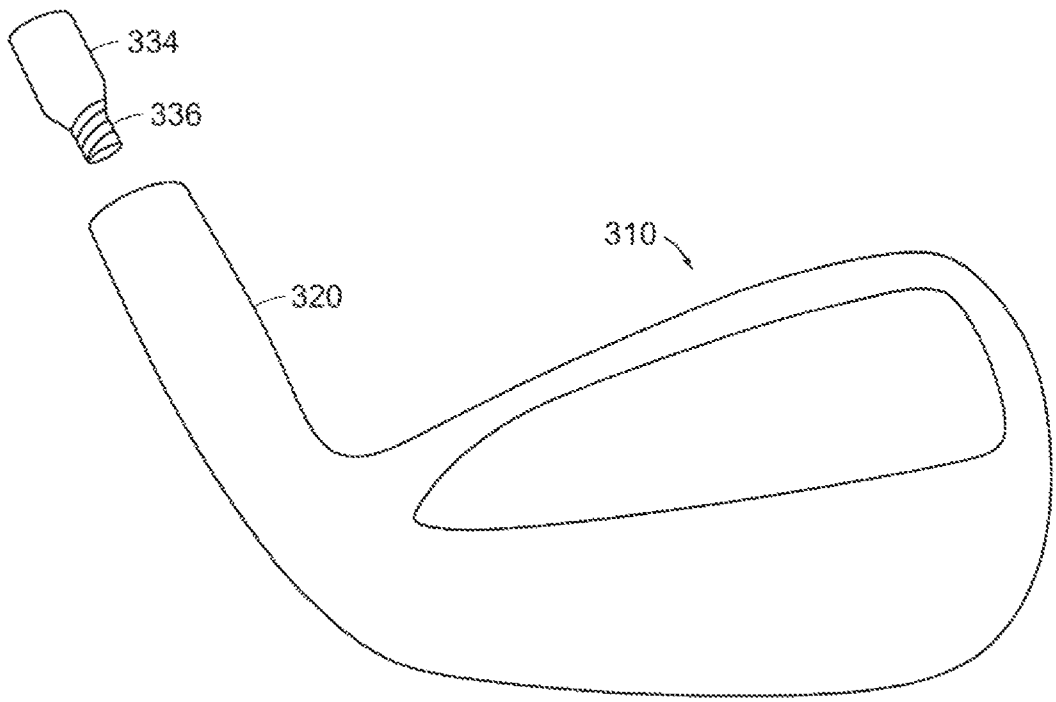

FIG. 9

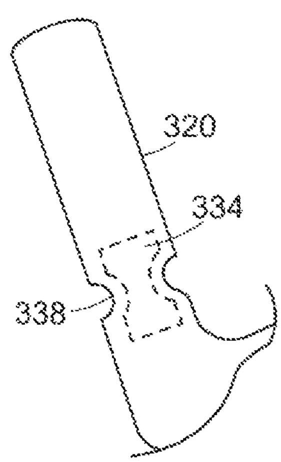

FIG. 10

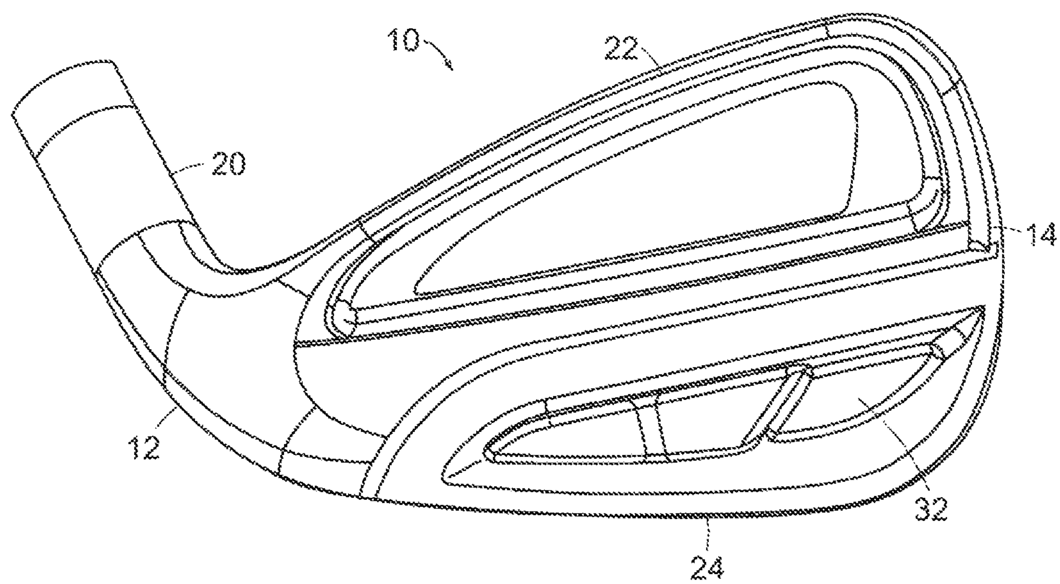

FIG. 11

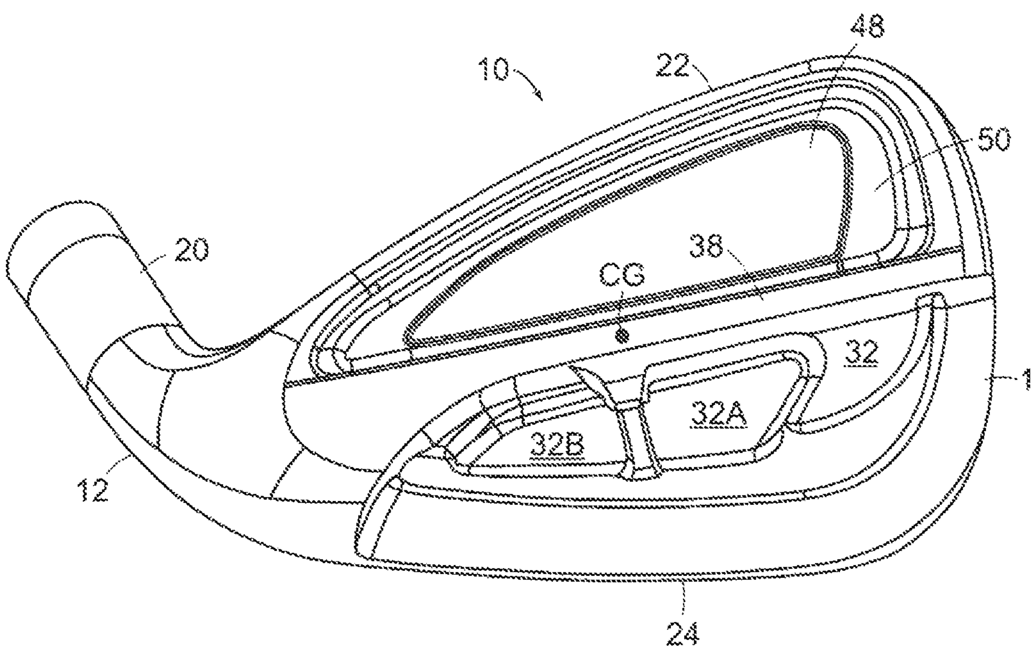

FIG. 12

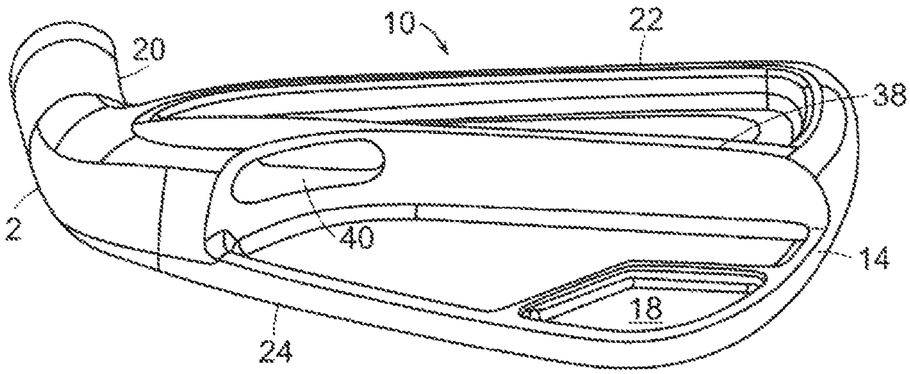

FIG. 13

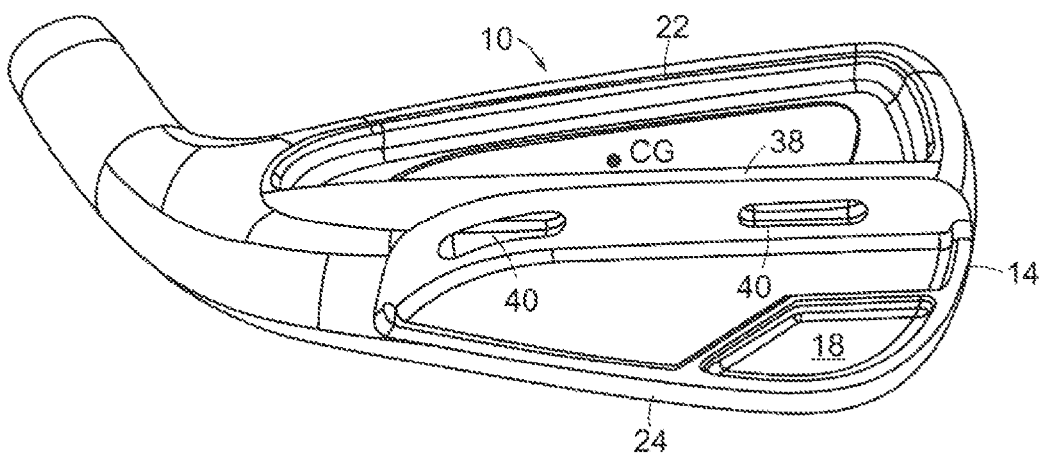

FIG. 14

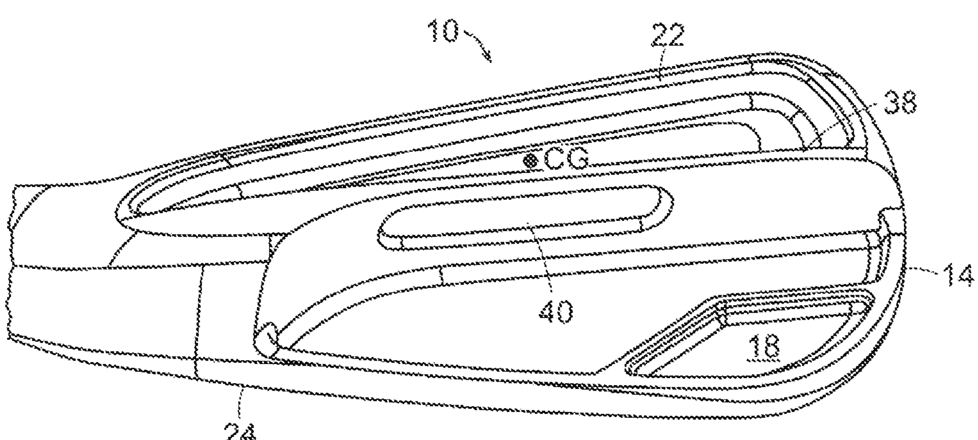

FIG. 15

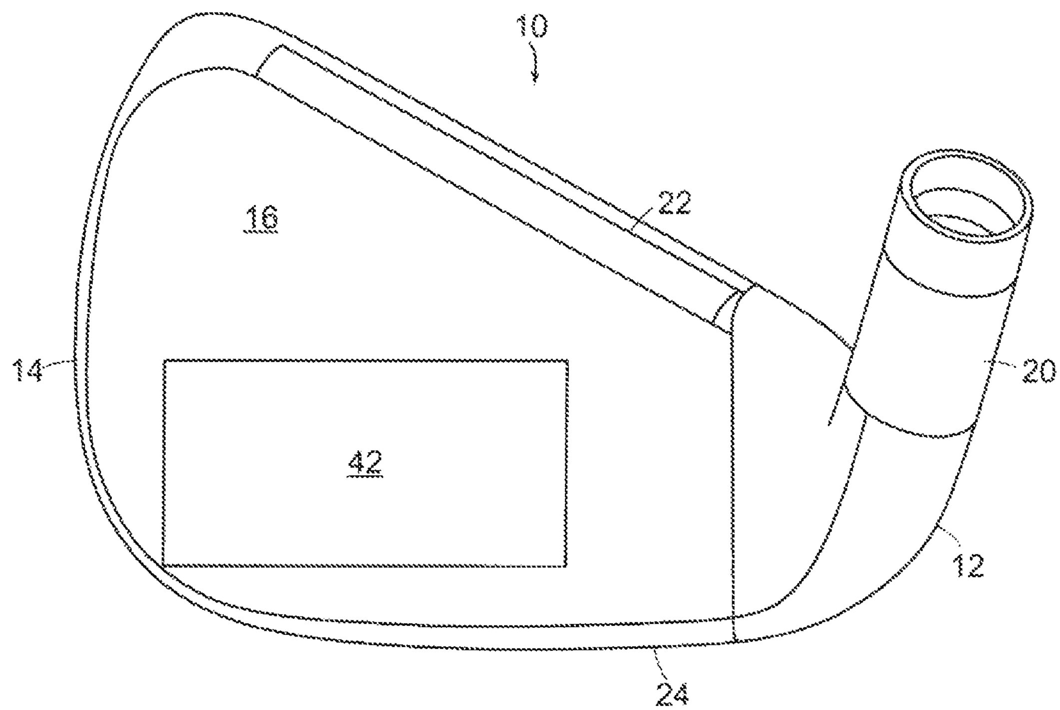

FIG. 16

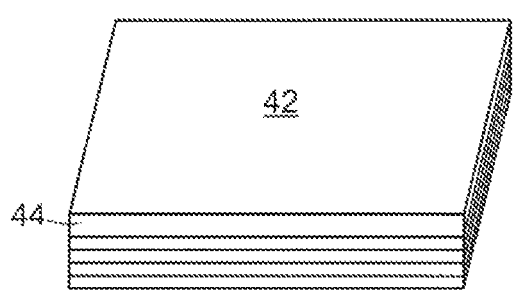

FIG. 17

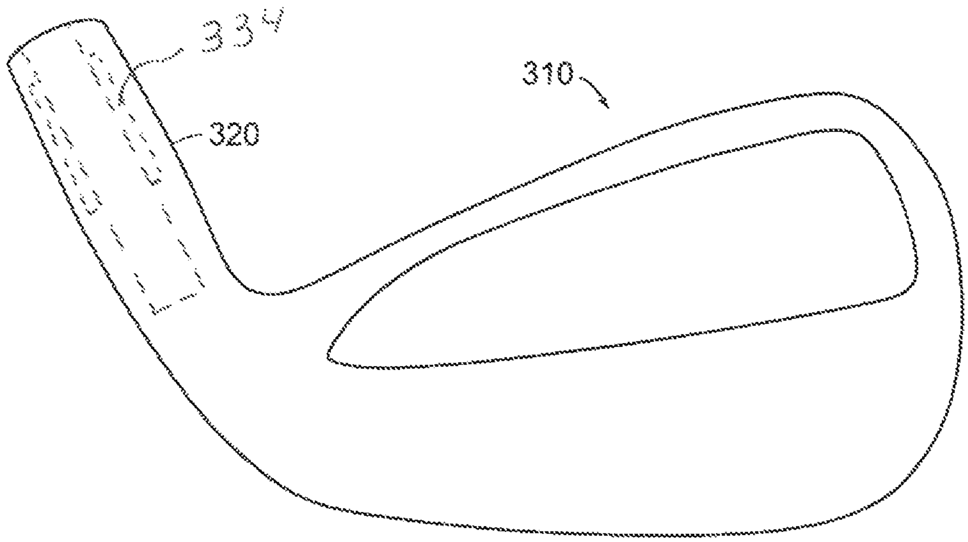

FIG. 18

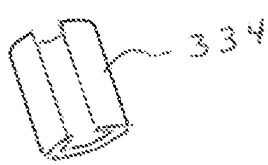

FIG. 19

PROGRESSIVE IRON SET

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

The present application is a continuation-in-part of U.S. application Ser. No. 13/887,701, filed on May 6, 2013, titled “PROGRESSIVE IRON SET” the disclosure of which is hereby incorporated herein by reference in its entirety and is to be considered a part of this specification.

TECHNICAL FIELD OF THE INVENTION

The present invention generally relates to sets of iron golf clubs, and more particularly, to sets of iron golf clubs that provide a progressive center of gravity allocation.

BACKGROUND OF THE INVENTION

In conventional sets of “iron” golf clubs, each club includes a shaft with a club head attached to one end and a grip attached to the other end. The club head includes a face for striking a golf ball. The angle between the face and a vertical plane is called “loft.” In general, the greater the loft is of the golf club in a set, the greater the launch angle and the less distance the golf ball is hit.

A set of irons generally includes individual irons that are designated as number 3 through number 9, and a pitching wedge. The iron set is generally complimented by a series of wedges, such as a lob wedge, a gap wedge, and/or a sand wedge. Sets can also include a 1 iron and a 2 iron, but these clubs are generally sold separate from the set. Each iron has a shaft length that usually decreases through the set as the loft for each club head increases, from the long irons to the short irons. The length of the club, along with the club head loft and center of gravity impart various performance characteristics to the ball’s launch conditions upon impact. The initial trajectory of the ball generally extends between the impact point and the apex or peak of the trajectory. In general, the ball’s trajectory for long irons, like the 3 iron, is a more penetrating, lower trajectory due to the lower launch angle and the increased ball speed off of the club. Short irons, like the 8 iron or pitching wedge, produce a trajectory that is substantially steeper and less penetrating than the trajectory of balls struck by long irons. The highest point of the long iron’s ball flight is generally lower than the highest point for the short iron’s ball flight. The mid irons, such as the 5 iron, produce an initial trajectory that is between those exhibited by balls hit with the long and short irons.

SUMMARY OF THE INVENTION

The present invention is direct to a set of golf clubs comprising long irons, mid-irons and short irons. The long irons are defined as having a loft angle (LA_1) of between 15 and 25 degrees and have a first center of gravity positioned horizontally from the face center by a first distance. The mid-irons are defined as having a loft angle (LA_2) of between 26 and 36 degrees and have a second center of gravity positioned horizontally from the face center by a second distance. The short irons are defined as having a loft angle (LA_3) of between 37 and 47 degrees and having a third center of gravity positioned horizontally from the face center by a third distance. The first distance and the second distance are preferably similar and the third distance is at least about 30 percent greater than the first and second distances. Preferably, the first and second distances are between about 1 mm and 3 mm and the third distance is between about 3 mm and 4 mm. Moreover, it is preferred that the third distance is greater than about 15 percent of the vertical distance of the center of gravity position from the ground.

Another aspect of the present invention is having at least 2 long irons, at least 2 mid-irons and at least 2 short irons, wherein each of the long irons has a center of gravity positioned horizontally from the face center that is between about 0 mm and 2.5 mm, each of the mid-irons has a center of gravity positioned horizontally from the face center that is between about 0 mm and 2.5 mm and each of the short irons has a center of gravity positioned horizontally from the face center by about 3 mm to 4 mm. Within this set, it is preferred that the long irons and mid-irons all contain heel and toe weights that are spaced from each other by at least 75% of the blade length and have weight center of gravities that are below the center of gravity for the iron itself. Further it is preferred that at least one of the short irons contains a weight member that has a weight center of gravity that is located above the center of gravity of the iron. Furthermore, the short iron weight member is preferably located on the heel side of the iron, and most preferably, within the hosel of the iron.

Another aspect of the present invention is a set of golf clubs comprising a long iron, a mid-iron and a short iron, wherein the center of gravity location for the short irons are greater than the values defined by the line CG-Xfc=0.02(LA)+2, where CG-Xfc is the distance of the center of gravity from the face center in the horizontal direction toward the hosel and LA is loft angle.

Still yet another aspect of the present invention is a set of golf clubs comprising at least a long iron, a mid-iron and a short iron, wherein the short iron has a moment of inertia about the shaft axis that falls below the line defined by the linear equation MOI-SA=4.6(LA)+400, wherein MOI-SA is the moment of inertia about the shaft axis and LA is the loft angle. Preferably, the set also includes a very short iron having a moment of inertia about the shaft axis of between 575 kg*mm^2 and 600 kg*mm^2. It is also preferred that the short iron has a center of gravity height CG-Yg and the CG-Xfc is greater than about 15% of the CG-Yg.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a back view of a long iron according to the present invention;

FIG. **2** is a back view of a mid-iron according to the present invention;

FIG. **3** is a back view of a short iron according to the present invention;

FIG. **4** is a back view of another embodiment of a short iron according to the present invention:

FIG. **5** is a graph depicting the center of gravity of a set of irons according to the present invention:

FIG. **6** is a graph depicting the moment of inertia about the shaft axis for a set of irons according to the present invention;

FIG. **7** is a back view of another embodiment of a short iron according to the present invention:

FIG. **8** is an exploded view of a long iron construction according to the present invention;

FIG. **9** is an exploded view on a short iron according to the present invention

FIG. **10** is a close up view of a hosel of a short iron according to another embodiment of the present invention;

FIG. **11** is a portion of a long iron according to another embodiment of the present invention;

FIG. **12** is a portion of a mid-iron according to another embodiment of the present invention;

FIG. **13** is a portion of a long iron according to another embodiment of the present invention;

FIG. **14** is a portion of a long iron according to another embodiment of the present invention;

FIG. **15** is a portion of a long iron according to another embodiment of the present invention;

FIG. **16** is a perspective view of a long iron according to another embodiment of the present invention;

FIG. **17** is an insert for a long iron according the embodiment set forth in FIG. **16**;

FIG. **18** is a back view of an iron according to the present invention; and

FIG. **19** is a perspective view of a weight member according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As illustrated in the accompanying drawings and discussed in detail below, the present invention is directed to an improved set of iron-type golf clubs, wherein the clubs have a center of gravity distribution that enables the player to hit more precise shots than conventional clubs.

Referring to FIG. **1**, a long iron club in the set includes a club head **10** attached to a shaft (not shown) in any manner known in the art, at a hosel **20**. The long irons of the present invention have a loft of between about 15 and 25 degrees as is well known in the art. Club head **10** includes, generally, the hosel **20**, a striking or hitting face and a back portion that can be cavity backed or muscle backed as is well known in the art. The club head also has a heel **12**, a toe **14**, a top line **22** and a sole **24**. As is well know in the art, the club head **10** and hosel **20** are designed such that the club has a center of gravity CG that is located between the toe **14** and heel **12** and between the top line **22** and the sole **24**, which will be discussed in more detail below.

In an embodiment of the invention, the long iron shown in FIG. **1** also includes a plurality of weight members **32** and **34**. The weight members may be embedded into a lower chamber or cavity as set forth in detail in U.S. Pat. No. 8,157,673, which is incorporated by reference in its entirety herein since the patent is entirely directed to the weight members used in the preferred type of construction, as set forth in FIGS. 1-13 and 25-40, and the frequencies of the preferred irons that can be made thereby, as set forth in FIGS. 14-24. Also, as shown in FIG. **1** herein, the heel weight **34** can be preferably inserted into an aperture machined into the sole **24** adjacent the heel **12**. As shown, the weight aperture can be formed to be coextensive with the shaft axis such that the weight **34** is located such that it is intersected by shaft axis SA. Alternatively, the weight aperture can be formed into the heel **12** adjacent the sole **24**, but would still be intersected by the shaft axis SA. In the preferred embodiment, the weight members **32** and **34** have a greater density than the material used to form the iron head **10** and preferably a density of greater than 2 times the density of the iron head **10**. Most preferably the weight members **32** and **34** have a density of about 17 g/cc.

In the iron head construction, the weight members **32** and **34** are sized and positioned to optimize the irons moment of inertia (MOI) about the vertical axis (VA) and the MOI about the shaft axis (SA). Preferably, the long iron weight members **32** and **34** are each between about 10 g and 40 g. Combined, the weight members **32** and **34** should comprise greater than about 10% of the total body weight. Preferably, the weight members **32** and **34** for the long irons are located such that the weight CGw is located below the club CG in the vertical direction. More preferably, the weight members **32** and **34** each have a CGw**1** and CGw**2**, respectively, that is between about 30% and 75% of the CG-Yg of the club. Still further, the CGw**1** and CGw**2** are preferably located a distance apart that is greater than 50% of the blade length of the club. More preferably, the CGw**1** and CGw**2** are located at least about 75% of the blade length away from each other to maximize MOI-Y. The iron head **10**, including the weight members **32** and **34**, is constructed such that the CG is also allocated in an optimal position relative to the face center and the shaft axis. The details of the CG locations of the irons within the set will be discussed in more detail below.

As shown in FIG. **2**, a mid-iron **110** according to the present invention has a loft of between about 26 and 36 degrees and includes, generally, the hosel **120**, a striking or hitting face and a back portion that can be cavity backed or muscle backed as is well known in the art. The club head also has a heel **112**, a toe **114**, a top line **122** and a sole **124**. As is well known in the art, the club head **110** and hosel **120** are designed such that the club has a center of gravity CG that is located between the toe **114** and heel **112** and between the top line **122** and the sole **124**, which will be discussed in more detail below.

In an embodiment of the present invention, the mid-iron shown in FIG. **2** also includes a plurality of weight members **132** and **134**. The weight members may be embedded into a lower chamber or cavity as set forth in detail in U.S. Pat. No. 8,157,673, which is incorporated by reference in its entirety herein since the patent is entirely directed to the weight members used in the preferred type of construction, as set forth in FIGS. 1-13 and 25-40, and the frequencies of the preferred irons that can be made thereby, as set forth in FIGS. 14-24. Also, as shown in FIG. **2** herein, the heel weight **134** can be preferably inserted into an aperture machined into the sole **124** adjacent the heel **112**. As shown, the weight aperture can be formed to be coextensive with the shaft axis such that the weight **134** is located in a location where it is intersected by shaft axis SA. Alternatively, the weight aperture can be formed into the heel **112** adjacent the sole **124**, but would still be intersected by the shaft axis SA. In the preferred embodiment, the weight members **132** and **134** have a greater density than the material used to form the iron head **110** and preferably a density of greater than 2 times the density of the iron head **110**. More preferably the weight members **132** and **14** have a density of about 14 to 17 g/cc. Most preferably the weight members **132** and **134** have different densities, wherein the density of the heel weight **134** is less than the density of the toe weight **132**. Preferably, the density of the heel weight **134** and the density of the toe weight **132** are about 14 g/cc and 17 g/cc, respectively.

In the iron head construction, the weight members **132** and **134** are sized and positioned to optimize the irons moment of inertia (MOI) about the vertical axis (VA) and the MOI about the shaft axis (SA). Preferably, the mid-iron weight members **132** and **134** are each between about 20 g and 50 g. Combined, the weight members **132** and **134** should comprise greater than about 15% of the total body weight. Preferably, the weight members **132** and **134** for the mid-irons are located such that at least one of the weight CGw is located below the club CG in the vertical direction. More preferably, the weight member **132** preferably has a CGw**3** that is between about 50% and 90% of the CG-Yg of the club and the weight member **134** has a CGw**4** that is approximate or greater than CG-Yg. Still further, the CGw**3** and CGw**4** are preferably located a distance apart that is greater than 50% of the blade length of the club. More preferably, the CGw**3** and CGw**4** are located at least about 50% and less than 80% of the blade length away from each other to optimize MOI-Y. The iron head **110**, including the weight members **132** and **134**, is constructed such that the CG is allocated in an optimal position relative to the face center and the shaft axis. The details of the CG locations of the irons within the set will be discussed in more detail below.

FIGS. **3** and **4** depict alternate embodiments of short irons according to the present invention **210** and **310**, respectively. The iron short iron according to the present invention has a loft of between 37 and 47 degrees. The iron **210** includes a hosel **220**, toe **214**, heel **212**, topline **222** and sole **224**. The iron **210** is constructed such that it has a center of gravity CG as discussed in more detail below. The iron **310** includes a hosel **320**, toe **314**, heel **312**, topline **322** and sole **324**. The iron **310** may have a heel weight member **334** located in the bottom portion of the hosel **320** such that it is intersected by the shaft axis SA. Preferably, the heel weight **334** has a specific gravity greater than the iron material, and more preferably, greater than about 2 times the specific gravity of the iron material. Preferably, the density of the heel weight is about 17 g/cc. Still further, the weight member **334** has a center of gravity CGw**5** that is located approximate or above the club CG in the vertical direction and is located a distance from the club CG that is greater than about 40% of the club blade length. Also, it is preferred that there is only a single high density weight member or no high density weight members such that the short irons **210** and **310** are constructed in a manner that they have a center of gravity CG as discussed in more detail below.

In accordance with an aspect of the present invention, the inventive iron golf clubs are designed to have progressive centers of gravity as set forth in FIG. **5**, for example and which is merely illustrative of a preferred embodiment of the present invention set of golf clubs, and is not to be construed as limiting the invention, the scope of which is defined by the appended claims. Each inventive iron golf club is designed to hit golf balls a prescribed distance in the air, and to stop on the green or fairway in a predictable manner.

Tables I and II provide exemplary, non-limiting dimensions for the various measurements of clubs according to the prior art and to the Example of the invention, respectively. It is fully intended that all of the dimensions set forth below can be adjusted such that the overall objective of the individual irons is met. As a non-limiting example, a 3 iron according to the invention can be made with a loft of 20-22 degrees to adjust the angle of descent and remain within the scope of the present invention.

TABLE I

	Club Number									
Model	2	3	4	5	6	7	8	9	P	W
loft	19	21	24	27	31	35	39	43	47	51
CG-Yg	19.4	18.9	18.6	18.5	18.3	18.2	18.3	18.1	18.0	17.8
CG-Bsa	36.0	35.9	35.7	35.7	35.6	35.7	35.4	35.4	35.4	35.0
CG-Zth	−7.8	−7.6	−8.0	−8.2	−8.9	−9.8	−9.9	−10.6	−12.0	−12.9
CG-Xfc	2.49	2.40	2.38	2.30	2.20	2.25	2.46	2.31	2.30	2.5
MOI-X	46	47	49	50	51	54	66	68	71	73
MOI-Y	231	233	238	242	248	262	270	276	293	296
MOI-Z	262	265	268	271	274	284	298	300	310	306
MOI-SA	491	493	505	522	547	562	570	588	622	634

TABLE II

	Club Number								
	3	4	5	6	7	8	9	P	W
loft	21	24	27	30	34	38	42	46	50
CG-Yg	18.7	18.5	18.6	18.6	18.6	19.4	19.2	19.1	18.7
CG-Bsa	35.7	35.6	35.6	35.6	35.3	35.1	35.3	34.2	34.1
CG-Zth	−7.5	−7.8	−8.2	−8.5	−9.1	−9.9	−10.8	−11.3	−12.1
CG-Xfc	2.4	2.5	2.4	2.4	2.7	3.3	3.0	4.1	4.0
MOI-X	46.2	47.8	49.3	49.8	51.9	62.4	66.0	69.3	73.0
MOI-Y	238.3	239.7	243.2	252.6	263.5	253.3	258.4	273.5	279.5
MOI-Z	268.1	269.2	271.7	278.6	286.2	279.7	280.7	290.0	290.3
MOI-SA	492.7	504.3	521.8	539.6	556.0	555.7	580.1	578.4	590.3

Referring to the data above and the graph in FIG. **5**, it is clear that in the irons according to the present invention the center of gravity is located a distance away from the face center CG-Xfc in a manner that is significantly different than with the prior art clubs. The face center is defined as the location that is in the middle of the scorelines and half way between the leading edge and the topline of the club. In the prior art clubs, the CG-Xfc remains substantially constant through the set. In general, the CG-Xfc in the prior art clubs is located between about 2 to 2.5 mm away from the face center towards the heel of the club (about 0.1 inch). In the irons according to the present invention, the CG-Xfc for the short irons range from about 40% to 60% further away from the face center than the long irons. More particularly, in the inventive example above and as shown in FIG. **5**, the CG-Xfc remains approximately constant at about 2.4 mm from the face center through the long irons and the mid-irons. All of the long irons (3 and 4) have a CG-Xfc that is within 15% of each other. All of the mid-irons (5, 6 and 7) have a CG-Xfc that is within 15% of each other. Further, all of the long irons (3 and 4) have a CG-Xfc that is within 15% of all of the mid-irons (5, 6 and 7). However, the short irons (8-W) have CGs that are substantially closer to the hosel or, in other words, substantially further away from the face center in the x (horizontal) direction. In fact, all of the example short irons have a CG-Xfc that is at least 40% greater than the CG-Xfc for the long irons. Preferably, all of the short irons according to the invention have a CG-Xfc that is at least 30% greater than the long irons and the mid-irons. More preferably, all of the short irons of the present invention have a CG-Xfc that is between 35% and 70% greater than the long irons and the mid-irons.

Moreover, as shown in FIG. **5**, the CG-Xfc of the irons according to the present invention varies through the set according to an exponential curve when plotted versus loft angle. As shown, in the irons according to the prior art, the CG-Xfc remains substantially constant, and thus, the CG-Xfc is substantially linear with no slope. Conversely, in the irons according to the present invention, the CG-Xfc remains substantially constant for long irons and mid-irons and then significantly increases for the short irons. Thus, the best fit equation to describe the relationship of the CG-Xfc according to loft is a second order polynomial. Preferably, the irons according to the present invention have a CG-Xfc for the short irons that are greater than the values defined by the line CG-Xfc=0.02(LA)+2.

Still further, the distance of the center of gravity to the ground CG-Yg remains similar for the clubs in the prior art and in the set according to the present invention. However, for the example set according to the present invention, the CG-Xfc is greater than 15% of CG-Yg for the short irons. For this example, the CG-Xfc ranges from about 15% to 20% of the CG-Yg for the short irons. Thus, the relationship of CG-Xfc to CG-Yg is substantially different than in the prior art clubs.

Referring to Table I and Table II above, the relationship of the moment of inertia about the shaft axis (MOI_SA) is substantially different between the prior art and the inventive clubs. In the very short irons, irons having a loft of between 45 and 52 degrees, the MOI-SA in the prior art is greater than 600 kg*mm^2 and closer to about 625 kg*mm^2. However, in the inventive irons set forth herein, the MOI-SA for the very short irons is less than 600 kg*mm^2 and more preferably between 575 kg*mm^2 and 600 kg*mm^2. As set forth in FIG. **6**, the MOI-SA for the prior art is best represented by a linear equation which is approximately MOI-SA=4.6LA+400. On the other hand, the MOI-Sa for the irons according to the present invention are best represented by a second degree polynomial equation. As shown, the MOI-SA for the short irons, including the very short irons, all fall below the linear equation of the prior art.

As set forth in Table II, the center of gravity distance from the ground CG-Yg within the set should be set to assist with the creation of the preferred flight paths. Options can include, for example, lowering the center of gravity of the long irons through the use of inserts formed from a material having a specific gravity of greater than 10 g/cc such as tungsten or a tungsten alloy. Additionally, the hosel of the long irons can be comprised of a material having a specific gravity of less than 7 g/cc such as titanium, aluminum or alloys thereof. Conversely, high specific gravity materials may be employed within the topline portion of the short irons to raise the center of gravity.

Referring to FIG. **7**, the short irons **310** according to the present invention, may employ a heel weight member **334** located in the bottom portion of the hosel **320** that is treaded in using a threaded section **336**, such that it is intersected by the shaft axis SA. Preferably, the heel weight **334** has a specific gravity greater than the iron material, and more preferably, greater than about 2 times the specific gravity of the iron material. Preferably, the density of the heel weight is about 17 g/cc. The iron **310** may also include a low weight insert **332** or an aperture that is formed from the toe section **314** so that the CG-Xfc is formed closer to the shaft axis. Preferably, the low weight insert **332** would have a specific gravity of less than the specific gravity of the iron material, and more preferably, about half of the specific gravity of the iron material or less. The low weight insert may be formed from a low specific gravity metal such as aluminum or an elastomeric material.

FIG. **8** is an exploded view of the components forming the long iron **10** as shown in FIG. **1**. The long iron can be formed by forging the body **10**, including a weight pocket **18** adjacent the toe section **14**. After the body **10** is formed, an aperture can be formed in the sole **24**, near the heel **12**, such that a weight insert **32** can be securely fastened therein by a press fit, welding or adhesive. After the toe weight **32** is attached in the weight pocket **18**, a back panel **16** can be secured to the body **10**. Preferably, the back panel and the body are formed from the same materials such that they can be welded together.

Referring to FIGS. **9** and **10**, the short irons according to the present invention may be formed by forging the body **310**. The body may include a back panel welded to the body as set forth in FIG. **8**, but may be solid. The weight member **334** is preferably formed with a threaded portion **336** and is threaded into the bottom of the hosel **320**. Alternatively, as shown in FIG. **10**, a weight member **334** may be inserted into the hosel **320** and then a compressive force can be applied to the perimeter of the hosel **320** to form a crimped section **338** that retains the weight member securely in the hosel **320**. The diameter of the crimped section **338** of the hosel **320** should be greater than 80% of the hosel diameter and more preferably between 90 and 95% of the hosel diameter.

Referring to FIG. **18**, irons according to the present invention may be formed by forging or casting the body **310** from titanium or steel. The body may include a back panel welded to the body as set forth in FIG. **8**, but may be solid. A weight member **334** is preferably formed as a weighted sleeve member that can be inserted into the hosel **320** and has an inner diameter that is equal to the outer diameter of a golf shaft such that the golf shaft can be inserted and adhesively affixed therein. Preferably, the weighted sleeve member **334** is formed of tungsten with a density of 15-17 g/cc such that the density is at least 75% greater than the iron and is press fit into the hosel. In one embodiment, the hosel can be heated and the weighted sleeve member cooled so that it can be easily inserted into the hosel. Once the hosel **320** and the weighted sleeve member **334** are at equal temperatures, the weighted sleeve member **334** is press fit into place.

Alternatively, as shown in FIG. **19**, a weighted sleeve member **334** may be a spring loaded sleeve with a longitudinal slit such that the weighted sleeve member can be compressed and then released to be securely held in the hosel **320**. The outer diameter of the weighted sleeve member **334** should be greater than about 100% of the hosel inner diameter and more preferably between 100 and 120% of the hosel inner diameter. The weighted sleeve member **334** has a length that is less than the hosel length. Preferably, the weighted sleeve member **334** has a length that is between about 30 and 80% of the hosel bore length. In one embodiment, the weighted sleeve member can be adhesively affixed into the hosel and the golf shaft can be adhesively affixed to the weighted sleeve member **334** and the lower portion of the hosel bore.

In one embodiment of the invention, the weighted sleeve member **334** is added to the hosel bore in an iron having a loft of less than about 25 degrees along with a weight member **32** in the toe such as that disclosed in FIG. **1**. Preferably, the center-to-center distance between the weighted sleeve **334** and the weight member **32** is at least 75% of the blade length and the iron has a MOIy of greater than 240 kg*mm^2. By using the weighted sleeve member, the distance between the weight members is maximized and the MOIy is maximized while maintaining a high MOIx. Preferably, the MOIx is greater than about 50 or 2 times the loft angle. Preferably, the weight members both have a specific gravity of greater than 15 g/cc, however if a 10 g/cc tungsten is used, the weight members **334** and/or **32** can be welded into place.

Referring to FIG. **11**, in an alternate embodiment of the present invention, the club head **10** can be formed by forging the body with weight pads **32**. Thus, in this embodiment, the weight members **32** are integrally formed with and attached to the back portion of the face. The back panel **16** as set forth above can then be welded over the weight member **32**. This construction method may be preferred for the long irons, mid irons or short irons of the present invention. However, referring to FIGS. **11** and **12**, if the long irons and mid irons are formed according to this method, it is preferred that the weight member **32** for the mid irons is located adjacent the face stabilizing bar **38** for the mid-irons and adjacent the sole **24** for the long irons. In this manner, the CG-Yg is designed to be relatively lower in the long irons than in the mid-irons. Also, as shown in FIG. **12**, the weight member **32** can be formed into multiple portions **32**A and **32**B that are preferably located on opposite sides of the CG to provide a relatively high MOI-Y. The CG location through the set can also be adjusted by providing for a variable face thickness above the stabilizing bar **38**. The upper back wall **48** can be designed a depth from the front face such that the upper face thickness through the set increases with loft. For example, the long irons can be designed with an upper face thickness of about 2.1 mm, the mid irons can have an upper face thickness of about 2.4 mm to 2.7 mm and the short irons can have an upper face thickness of about 2.7 mm to 3.5 mm. The perimeter of the upper face **50** can be about 0.05 to 0.25 mm thicker than the center portion **48**. Preferably, the upper face thickness is as thick as or thicker than the next club in the set with a lower loft and the upper face thickness of a short iron is at least 50% greater than the upper face thickness of a long iron.

Yet another way to design an iron having the CG according to the present invention is to form a body **10** as shown in FIG. **13**. The head body **10** can be formed by forging the body with a topline **22**, sole portion **24**, toe portion **14**, heel portion **12**, a weight pocket **18** and a face stabilizing bar **38**. If the member is forged, an aperture **40** can be formed in the face stabilizing bar **38** prior to the attachment of the back panel **16**. Preferably, the aperture is machined into at least a portion of the face stabilizing bar **38**. If the body is cast, the aperture **40** can be formed in the casting and machining can be avoided. Referring to FIG. **14**, more than one aperture **40** may be desired. Thus, the club **10** may include one or more apertures formed into the face stabilizing bar **38**. Preferably, the apertures are located on the sole side of the face stabilizing bar **38** and are covered by a back panel **16**. In yet another embodiment as set forth in FIG. **15**, the aperture **40** can extend longitudinally from the heel **12** to the toe **14** a distance of greater than about 25% and less than about 50% of the length of the face stabilizing bar **38**. Preferably, the aperture **40** extends through the face stabilizing bar **38** toward the topline by about 50% to about 90%. By forming the aperture **40** such that is extends on both sides of the CG as shown in FIG. **15**, the MOI-Y can be optimized. Although not shown, similar apertures can be form in the bottom surface of the topline **22**.

Another way to accomplish the progression of the center of gravity CG-Yg through the set is to employ a low weight face insert as shown in FIGS. **16** and **17**. Referring to FIG. **16**, the face **16** can be made of different materials throughout the set. For example, the long irons could employ a titanium alloy insert such as Ti 6-4, which has a specific gravity of 4.4 g/cc and the mid-irons and short irons could employ steel faces having a specific gravity of about 7.9 g/cc. By using higher strength steel in the mid-irons, such as 17-4 stainless steel, the faces can be designed thin to reduce weight and by using a softer steel, such as 431 stainless steel, in the short irons, the feel of the short irons can be improved. Also, as shown in FIG. **17**, a composite insert **42** comprised of multiple layers of prepreg layups **44** may be used. Preferably, a face insert **42** can be located in a thin cavity behind the face material **16** that can be the same material as the body **10**. The insert **42** should extend longitudinally at least about 50% between the heel **12** and the toe **14**. The height of the insert can be varied, but is preferably between at least 10% and 90% of the height of the iron between the sole **24** and the topline **22**.

Another aspect of the preferred embodiment is to have a consistent feel within the set. Thus, the swing weights of the irons may be constant through the set. Furthermore, the distance from the center of gravity to the shaft axis can be approximately constant through the set or progress through the set inversely to the loft.

While it is apparent that the illustrative embodiments of the invention disclosed herein fulfill the objectives stated above, it is appreciated that numerous modifications and other embodiments may be devised by those skilled in the art. Therefore, it will be understood that the appended claims are intended to cover all modifications and embodiments which would come within the spirit and scope of the present invention.

What is claimed is:

1. A set of golf clubs comprising at least a first golf club, a second golf club, and a third club, wherein:

the first, second and third golf clubs each comprising a heel, a toe, an upper surface, a lower surface, a hosel and a front face having a face center, wherein at least one of the clubs includes a weighted sleeve member inserted into the hosel having a specific gravity that is at least 75% greater than the golf club, and

the first golf club further comprising a first loft angle (LA_1) of between 15 and 25 degrees and a first center of gravity positioned horizontally from the face center toward the hosel by a first distance, the second golf club comprising a second loft angle (LA_2) of between 26 and 36 degrees and a second center of gravity positioned horizontally from the face center toward the hosel by a second distance, and

the third golf club comprising a third loft angle (LA_3) of between 37 and 47 degrees and a third center of gravity positioned horizontally from the face center toward the hosel by a third distance,

wherein the first distance and the second distance are approximately constant and the third distance is at least 30 percent greater than the first distance.

2. The set of golf clubs of claim **1**, wherein the third distance is between 35 percent and 70 percent greater than the first distance.

3. The set of golf clubs of claim **1**, wherein the first and second distance are between about 1 mm and 3 mm.

4. The set of golf clubs of claim **3**, wherein the third distance is between about 3 mm and 4 mm.

5. The set of golf clubs of claim **1**, wherein, for the third golf club, the third distance is greater than about 15 percent of a center of gravity position measured vertically from the ground.

6. The set of golf clubs of claim **1**, wherein the set is comprised of at least 2 golf clubs comprising a loft angle (LA) of between 15 and 25 degrees, at least 2 golf clubs comprising a loft angle (LA) of between 26 and 36 degrees and at least 2 golf clubs comprising a loft angle (LA) of between 37 and 47 degrees,

wherein each of the 2 clubs having a loft angle (LA) of between 15 and 25 degrees has a center of gravity positioned horizontally from the face center a distance of between about 0 mm and 2.5 mm;

wherein each of the 2 clubs having a loft angle (LA) of between 26 and 36 degrees has a center of gravity positioned horizontally from the face center a distance of between about 0 mm and 2.5 mm; and

wherein each of the 2 clubs having a loft angle (LA) of between 37 and 47 degrees has a center of gravity positioned horizontally from the face center toward the heel a distance of between about 3 mm and 4 mm.

7. The set of golf clubs of claim **6**, wherein each of the 2 clubs having a loft angle (LA) of between 15 and 25 degrees is further comprised of a weighted sleeve member inserted into the hosel and a toe weight formed from a material having a specific gravity of greater than about 15 g/cc.

8. The set of golf clubs of claim **7**, wherein each of the 2 clubs having a loft angle (LA) of between 26 and 36 degrees is further comprised of a weighted sleeve member inserted into the hosel and a toe weight formed from a material having a specific gravity of greater than about 15 g/cc.

9. The set of golf clubs of claim **8**, wherein at least one of the 2 clubs having a loft angle (LA) of between 37 and 47 degrees is further comprised of a weighted sleeve member inserted into the hosel and formed from a material having a specific gravity of greater than about 15 g/cc.

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